

Toward the Future

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HERE has never been a time of greater need for the *Journal of Propulsion and Power* (JPP). Any number of indicators show that this is a time of significant change for the aerospace industry. Whether it be achieving energy independence through alternative fuels, achieving environmental compatibility through green propellants, the controversies over space exploration, the policies of changing leaderships in the United States and around the world, or rapidly emerging technical capabilities such as in modeling and simulation, all of these portend significant changes for propulsion and power. The JPP is needed to document these changes. Perhaps more importantly, new requirements, whether they be driven by new military missions or new civilian statutory, economic, or other factors, will drive propulsion and power systems into regimes they have never before encountered. The JPP is needed to provide a forum for the exchange of information and intellectual ideas to facilitate meeting these new requirements.

The readers of JPP have grown accustomed to high standards of quality in editing and intellectual content. Most assuredly these standards will continue to be enforced. Readers also expect to be informed of the most recent developments in important technical areas through special issues and review papers. They may continue to look forward to these features as well. However, readers also need to be able to anticipate future trends in order to best be able to prepare for them. Accordingly, expect to find periodic position papers in future issues from technological leaders describing these trends and the technical reasons for them. Interested authors are encouraged to contact me.

The most immediate challenge for the journal is to successfully manage the transition from WriteTrack to the new manuscript management system, ScholarOne. The transition is occurring even as this issue goes to press. Authors, reviewers, and Associate Editors may be assured that I and the publications and IT staff at AIAA are dedicated to make the transition as efficient and as transparent as possible.

I feel fortunate to have an exceptional team of Associate Editors and staff at AIAA to work with to facilitate the publication of quality papers documenting the research of highly talented researchers. I feel fortunate as well to have available to me the advice of an outstanding Editorial Advisory Board. I am especially grateful for the support of my predecessor, Dr. Vigor Yang. Dr. Yang has guided this journal as Editor-in-Chief since 2001 and served as an Associate Editor for ten years before that. It is due in no small part to his wise leadership that the JPP enjoys the prominence it does today. He has been exceedingly helpful to me during my transition into this position. I am happy to report that he has accepted a position on the JPP Editorial Advisory Board. We will not lose the benefit of his guidance.

Announcements and Acknowledgments

This section presents recent policy and personnel changes and acknowledges services to the *Journal of Propulsion and Power* (JPP).

Editorial Advisory Board. We are indebted for the continuing services of the Editorial Advisory Board, whose primary functions are 1) to help define editorial policy and operation, 2) to provide advice to the Editor-in-Chief, 3) to promote emerging technologies and related research and development, and 4) to help recruit Associate Editors. The biographies and photographs of the 16 board members, representing most, if not all, of the important disciplines in aerospace propulsion and power, are listed in the following pages, together with those of the Associate Editors. The contributions of these individuals in helping to maintain and improve the quality of the journal are gratefully acknowledged.

Reappointed Associate Editors. Readers of the *JPP* are indeed fortunate to have a strong group of Associate Editors (AEs) processing the reviews of manuscripts. We are fortunate this year that Alec D. Gallimore, *University of Michigan*, and Joseph C. Oefelein, *Sandia National Laboratories, Livermore* have both agreed to serve another three-year term as AEs. Their continued presence will help maintain the editorial continuity of the journal. We deeply appreciate their exemplary service and ongoing commitment.

Newly Appointed Associate Editors. Four new Associate Editors will be added to the masthead this year. Eun S. Kim is Manager of the Propulsion Department, Vehicle Systems Division, at *The Aerospace Corporation*. He brings considerable expertise in liquid and solid rocket propulsion, and he also has a background in advanced gas turbine combustors. Lyon B. King, *Michigan Technological University*, is widely known for his expertise in plasma physics, electric space propulsion, and spacecraft systems. Jerry M. Seitzman, *Georgia Institute of Technology*, brings expertise in the fields of optical flow diagnostics and sensors, combustion and combustion control, high-temperature gas dynamics, laser spectroscopy, flowfield imaging, and solid propellant combustion. Finally, Robert Miller, *Cambridge University*, has a strong background in unsteady flows, compressors and turbine aerodynamics, transition, effects of manufacturing variation, pressure gain combustion for gas turbines, unsteady propulsion, and energy and the environment. We welcome these outstanding individuals and thank them for agreeing to serve.

Continuing Associate Editors. Individuals who will continue their service as Associate Editors this year are John J. Blandino, *Worcester Polytechnic Institute*, Rodney D.W. Bowersox, *Texas A&M; University*, Kader Frendi, *University of Alabama in Huntsville*, Ashwani Gupta, *University of Maryland*, Tim C. Lieuwen, *Georgia Institute of Technology*, Feng Liu, *University of California, Irvine*, Lourdes Q. Maurice, *Federal Aviation Administration*, Joseph M. Powers, *University of Notre Dame*, Corin Segal, *University of Florida*, Steven F. Son, *Purdue University*, Gregory G. Spanglers, *U.S. Air Force Research Laboratory*, and Choon Sooi Tan, *Massachusetts Institute of Technology*. The dedication of these individuals to the journal is greatly appreciated.

Retiring Associate Editors. Thanks are due to our retiring Associate Editors: Edgar Choueiri, *Princeton University*; Anil Prasad, *Pratt & Whitney*; and C. Thomas Avedesian, *Cornell University*. Their service to the journal is greatly appreciated. Professor Avedesian's long history of service to the journal is especially acknowledged with our deepest gratitude.

Acknowledgments. Sincere thanks are due to the editorial staff of the AIAA, as follows: Michael B. Bragg, (Vice President-Publications), Rodger S. Williams (Director of Publications), Amanda Maguire (Product Manager, Journals), and Becky Rivard (Managing Editor, JPP). These individuals provided invaluable assistance to my predecessor, and they were of great help to me during my transition into this position. The publication staff at Beacon, coordinated by Carol Zaugg, is gratefully acknowledged. The individuals who have very generously contributed their time and expertise in reviewing the manuscripts also deserve special recognition. Their names appear in the following pages. Finally, we owe a large debt of gratitude to all of the authors who have prepared the fine papers that have appeared in this journal.

Douglas G. Talley
Editor-in-Chief

Editor-in-Chief



DOUGLAS G. TALLEY, received his B.S. in engineering from Oakland University and then began his career as a Naval Nuclear Engineer aboard a U.S. submarine in 1976. He entered graduate school following Naval service, earning an M.S. and Ph.D. in mechanical engineering from Carnegie-Mellon University in 1982 and 1984, respectively. Following a teaching appointment at the University of Michigan, he accepted his present position in 1991 as a Senior Research Scientist in the Liquid Rocket Combustion Group, Propulsion Directorate, U.S. Air Force Research Laboratory (AFRL), a position that he still enjoys today. His general area of expertise is multiphase combustion and heat transfer, and he is currently engaged in basic research and exploratory development in liquid rocket propulsion. While at AFRL, he developed expertise in pulsed detonation rocket engines and pioneered an experimental program in high-pressure sprays and combustion related to liquid rocket engines, which has impacted several national programs. He is particularly well known for his work on injection and combustion at pressures exceeding the critical pressure of the propellants. He has over 50 publications, is a two-time winner of the W.R. Marshall Best Paper award, and is the winner of the Don Ross Distinguished Performance award. He is Treasurer of the Institute of Liquid Atomization and Spray Systems—Americas, sits on several advisory boards, and serves on the Editorial Board of the journal *Atomization and Sprays*. After having served for several years as an Associate Editor, he is currently Editor-in-Chief of the *Journal of Propulsion and Power*. He is a Senior Member of the AIAA.

Associate Editors



JOHN J. BLANDINO, Associate Professor of mechanical engineering at the Worcester Polytechnic Institute (WPI), received his B.S. in aeronautics from Rensselaer Polytechnic Institute, M.S. in aeronautics and astronautics from Massachusetts Institute of Technology, and Ph.D. in mechanical engineering from California Institute of Technology. Before joining the faculty at WPI, he was a Senior Staff Engineer in the Advanced Propulsion Technology Group at the Jet Propulsion Laboratory (JPL). His research at JPL included application of plasma sources for materials processing and the development of pulsed plasma and small-scale hydrazine thrusters. In the mission support area, he worked as the Propulsion Engineer for the Deep Space 3 Interferometer and Laser Interferometer Space Antenna Missions. His research interests at WPI include droplet characterization in colloid thruster plumes, hollow cathodes, thermal-fluid analysis of millinewton-class hydrazine thrusters, and drag-free spacecraft mission analysis. He is a Member of the AIAA Electric Propulsion Technical Committee and served as a Member of the NASA Space Technology 7 (ST-7) Mission Technology Review Board from 2002 to 2003. From 2004 to 2007 he served as Chair of the Critical Design Review Board for NASA's colloid micronewton thruster development activity for the ST-7 Mission. He has been a consultant in the area of electrospray applications for private industry and is currently an Associate Editor for the *JANNAF Journal of Propulsion and Energetics*. Dr. Blandino is a Senior Member of the AIAA.



RODNEY D. BOWERSOX is an Associate Professor of the Aerospace Engineering Department at Texas A&M University. He received his Ph.D. (1992), M.S. (1990), and B.S. (1988) in aerospace engineering from Virginia Polytechnic Institute and State University. His research interests include theoretical and experimental analyses of high-speed and unsteady flowfields with applications in aerodynamics and aerospace propulsion. He is experienced in gas dynamics, laser/optical experimental methods, flow control, and turbulence modeling. His research program has produced over 90 technical articles. He was awarded five Air Force Scientific Achievement Awards (1996–1997) and the Col. Charles A. Stone Award (1995) for leadership for his research program. He received the Lockheed Martin Excellence in Engineering Teaching Award in 2004. Dr. Bowersox is an Associate Fellow of the AIAA, and he serves on the HyTASP Committee. He also serves as a U.S. National Committee Member of the International Society for Air Breathing Engines.



KADER FRENDI is Professor of mechanical and aerospace engineering at the University of Alabama in Huntsville (UAH). He obtained his M.S. and Ph.D. in engineering and applied mathematics from Brown University. In September 1989, he joined Northeastern University as a Visiting Assistant Professor for one year. From September 1990 to August 1999, he worked in the Structural Acoustics Branch of NASA Langley Research Center as a Research Contractor. Since joining UAH in the summer of 1999, Dr. Frendi has established many research programs in applied computational fluid dynamics with funding from NASA and the U.S. Department of Defense. His research work spans the fields of acoustics, combustion, combustion–acoustic interactions, turbulence, and fluid–structure–acoustic interactions. He is an Associate Fellow of the AIAA.



ALEC D. GALLIMORE is an Arthur F. Thurnau Professor of aerospace engineering at the University of Michigan, where he directs the Plasmadynamics and Electric Propulsion Laboratory, and an Associate Dean at the Horace H. Rackham School of Graduate Studies. Professor Gallimore is also the director of the NASA-funded Michigan Space Grant Consortium. He received his B.S. in aeronautical engineering from the Rensselaer Polytechnic Institute in 1986 and his M.A. and Ph.D. in aerospace engineering from Princeton University in 1988 and 1992, respectively. His primary research interests include electric propulsion, plasma diagnostics, space plasma simulation, and nanoparticle physics. He has experience with a wide array of electric propulsion technologies, including Hall thrusters, ion engines, arc jets, and magnetoplasmadynamics thrusters, and he has implemented a variety of probe, microwave, and optical/laser plasma diagnostics. Professor Gallimore is the author of more than 200 journal and conference papers on electric propulsion and plasma physics. Professor Gallimore has served on a number of advisory boards for NASA and the U.S. Department of Defense, including the U.S. Air Force Scientific Advisory Board (AFSAB). He was awarded the Decoration for Meritorious Civilian Service in 2005 for his work on the AFSAB. Professor Gallimore also serves on the AIAA Electric Propulsion Technical Committee and is an Associate Fellow of the AIAA.



ASHWANI K. GUPTA is a Distinguished Professor of mechanical engineering at the University of Maryland. His academic experience includes six years as a Member of the Research Staff at Massachusetts Institute of Technology in the Energy Laboratory and Department of Chemical Engineering, three years as Senior Research Associate and independent research worker at Sheffield University in the Department of Chemical Engineering and Fuel Technology, and 17 years at the University of Maryland. He spent four months in Japan as a consultant to several companies. At present, he serves as an international consultant on a major project sponsored by the Japanese government. He is the author of over 150 publications in the areas of combustion, swirl flows, diagnostics, fuel sprays, hazardous waste thermal destruction, pollution, and alternative fuels. He has coauthored two books and edited seven books. Presently, he is Coeditor of the Energy and Environmental Series of books published by CRC Press. He has been the recipient of the AIAA Propellants and Combustion Award and Energy System Award, George Westinghouse Gold Medal of the American Society of Mechanical Engineers (ASME), and four Best Paper Awards from AIAA and ASME. Dr. Gupta received his Ph.D. from Sheffield University in 1973. He was awarded his D.Sc. from Sheffield University in 1986 for international recognition and publication of high-quality original research. Dr. Gupta is the AIAA Deputy Director of Energy and was previously the Chair of the AIAA Terrestrial Energy and Propellants and Combustion Technical Committees. Dr. Gupta is a Fellow of the AIAA, the ASME, and the Institute of Energy, and a Member of the Society of Automotive Engineers and the Combustion Institute.



EUN S. KIM is a manager in the Propulsion Department at The Aerospace Corporation (Aerospace). In this capacity, he is responsible for managing Aerospace's technical support to U.S. Air Force launch vehicle programs from concept design to launch operation in the areas of liquid and solid rocket propulsion. Prior to joining Aerospace, he was a lead design engineer at General Electric Aircraft Engines for advanced combustor development programs. He received his B.S., M.S., and Ph.D. degrees all in mechanical engineering from the Pennsylvania State University. He has authored/co-authored several book chapters and numerous technical papers on rocket propulsion and combustion. He is an Associate Fellow of the AIAA and a Technical Steering Group member of the JANNAF Liquid Propulsion Subcommittee.



LYON (BRAD) KING received his B.S., M.S., and Ph.D. degrees in aerospace engineering from the University of Michigan in 1993, 1995, and 1998, respectively. Prof. King is an active researcher in the areas of plasma physics, electric space propulsion, and spacecraft systems. Prof. King shared the AIAA Outstanding Paper in Electric Propulsion Award in 1999 for his doctoral studies on Hall thruster plume flows. He was awarded a National Research Council Postdoctoral Fellowship, which he performed in the Ion Storage Group of the National Institute of Standards and Technology, performing studies on laser-cooled ions and positrons in electromagnetic traps. Prof. King joined the faculty of Michigan Technological University in 2000, where he founded the Ion Space Propulsion Laboratory. In 2003 he was awarded the National Science Foundation Faculty Early Career Award (CAREER) for innovative studies of electron mobility in plasmas. In 2004 Prof. King received the U.S. Department of Defense Presidential Early Career Award for Scientists and Engineers (PECASE) in a White House ceremony due, in part, to innovations in Hall thruster design. In 2006 Prof. King received the SAE International Ralph R. Teeter Engineering Educator Award. Prof. King is a member of the JANNAF Electric Propulsion Technical Committee, is the Chair of the AIAA Electric Propulsion Technical Committee, and is an Associate Editor for the AIAA *Journal of Propulsion and Power*.



TIM C. LIEUWEN is an Associate Professor in the School of Aerospace Engineering at Georgia Institute of Technology. His research interests include combustion instabilities, combustion of alternative fuels, control of combustion phenomenon, flame/acoustic-wave interactions, combustion noise, and engine health monitoring. He was awarded the National Science Foundation Career Award in 2000, the Sigma XI Young Faculty Award in 2004, and the AIAA Lawrence Sperry Award in 2005. Dr. Lieuwen is on the Airbreathing Propulsion Technical Committee of the AIAA, where he serves as the Joint Propulsion Conference Planning Subcommittee Chair. He is also a Member of the Combustion and Fuels Committee of the American Society of Mechanical Engineers (ASME), where he serves as point contact. He is a Member of the AIAA, ASME, The Acoustical Society of America, the American Society for Engineering Education, and the Combustion Institute. He received his Ph.D. from Georgia Institute of Technology.



FENG LIU, Professor of mechanical and aerospace engineering at the University of California (UC), Irvine, received his B.S. (1982) from Northwestern Polytechnic University, M.S. (1984) from Beijing University of Aeronautics and Astronautics, and Ph.D. (1991) from Princeton University. His research interests include computational fluid dynamics; transonic, reactive, and two-phase flows; turbomachinery aerodynamics; aeroelasticity; and gas-turbine engine cycle innovation. He is the author or coauthor of more than 100 journal and conference papers. He was the recipient of the Outstanding Engineering Professor Award from the students of the Class of 2000 at UC Irvine. Dr. Liu is an Associate Fellow of the AIAA and a Member of the American Society of Mechanical Engineers. He serves on the AIAA Airbreathing Propulsion Technical Committee.



LOURDES Q. MAURICE is the Chief Scientific and Technical Advisor for Environment in the Federal Aviation Administration's Office of Environment and Energy. She serves as the agency's Technical Expert for basic and exploratory research and advanced technology development focused on aircraft environmental impacts and its application to noise and emissions certification. She previously served as the Air Force Deputy, Basic Research Sciences and Propulsion Science and Technology, in the office of the Deputy Associate Secretary of the Air Force Institute for Science and Technology. She also worked at the U.S. Air Force Research Laboratory's Propulsion and Power Directorate from 1983 to 1999 planning and executing basic, exploratory, and advanced development propulsion science and technology programs, focusing on state-of-the-art aviation fuels and propulsion systems. Her areas of expertise include pollutant formation chemistry, combustion kinetics, hypersonic propulsion, and aviation fuels. She received her B.Sc. in chemical engineering and M.Sc. in aerospace engineering from the University of Dayton and her Ph.D. in mechanical engineering from the University of London's Imperial College. She is also a Distinguished Graduate of National Defense University's Industrial College of the Armed Forces, where she earned a M.Sc. in National Resource Strategy. Dr. Maurice has served as an advisor to the United Nation's Intergovernmental Panel on Climate Change and the National Academies of Science National Research Council. She is an Associate Editor for AIAA's *Journal of Propulsion and Power* and serves on the Editorial Board of the *International Journal of Aeroacoustics*. She has authored over 90 publications and is has been a Fellow of the AIAA since 2003.



ROBERT MILLER is Reader in Energy Technology at the Whittle Laboratory, Cambridge University. He obtained his MA and D.Phil at St Catherine's College, Oxford University and went on to hold the Spooner Research Fellowship at New College Oxford. In 2001 he was appointed to a Lectureship in Turbomachinery at the Whittle Laboratory in Cambridge. His research expertise includes compressor and turbine aerodynamics, heat-transfer, manufacturing effect in gas turbines, novel high temperature engine instrumentation, MEMs instrumentation, pressure gain combustion for gas turbines and unsteady propulsion. He has undertaken research with Rolls Royce, Mitsubishi and Siemens. In 2004 he spent the summer as a visiting researcher in the Compressions Systems department at Rolls Royce. He is a member of AIAA and ASME, a member the EPSRC Peer Review College, a UK representative on the organizing committee for the European Turbomachinery Conference and has served as a Vanguard Chair for IGTI. He has 40 publications, has been a recipient of three ASME best paper awards and one AIAA Airbreathing Propulsion best paper award.



JOSEPH C. OEFELIN received a Ph.D. in mechanical engineering from Pennsylvania State University in 1997, an M.S. in mechanical engineering from Pennsylvania State University in 1992, and a B.S. in mechanical engineering from Rutgers University in 1989. He is currently employed as a Principal Member of the Technical Staff at the Sandia National Laboratories Combustion Research Facility. His research interests are interdisciplinary, with focus on the theory, numerical modeling, and analysis of complex fluid flows in which turbulence, combustion, high-pressure phenomena, or multiphase phenomena play a controlling role. Concurrent interests are focused in the general area of numerical methods for partial differential equations, with emphasis placed on computational fluid dynamics, applied numerical analysis, large-scale scientific computing, and parallel processing. He has extensive experience in the development and application of the large-eddy-simulation technique and the related subgrid-scale models to both fundamental flows and device-scale components such as liquid-rocket injectors, gas-turbine combustors, and internal-combustion engines. He is an Associate Fellow of the AIAA.



JOSEPH M. POWERS, Professor of aerospace and mechanical engineering and Concurrent Associate Professor of mathematics at the University of Notre Dame, received his B.S., M.S., and Ph.D. in mechanical engineering from the University of Illinois at Urbana–Champaign in 1983, 1985, and 1988, respectively. His research interests include computational mechanics, scientific computing, detonation theory, pyrotechnic combustion, high-speed propulsion, transition to detonation in solid propellants, high-speed flows in reactive porous media, numerical and theoretical methods for multiscale phenomena, and systematic reduction of large systems of chemical kinetics. He is the author of several papers in the archival literature and has supervised many M.S. and Ph.D. students since joining the faculty in 1989. He has held summer appointments at NASA John H. Glenn Research Center at Lewis Field, the U.S. Air Force Wright Laboratories at Eglin Air Force Base, Los Alamos National Laboratory, and Argonne National Laboratory. He is the recipient of the University of Notre Dame's Amoco College of Engineering Outstanding Teacher of the Year Award in 1994 and Department Faculty Award in 1997. He presently holds the 2006–2007 Kaneb Faculty Fellowship for teaching and scholarship. He received a NASA Innovative Technology Award in 1999. Dr. Powers is a Member of American Physical Society, Society for Industrial and Applied Mathematics, American Society of Mechanical Engineers, American Society for Engineering Education, the Combustion Institute, and he is an Associate Fellow of the AIAA.



CORIN SEGAL is an Associate Professor of mechanical and aerospace engineering at the University of Florida. He received his B.S. and M.S. from the Polytechnic Institute of Bucharest and his Ph.D. from the University of Virginia. He has more than a decade of experience in the aerospace industry as a Research Engineer, Project Manager, and Aerodynamicist, covering mostly internal aerodynamics in airbreathing engines. His current research interests include mixing and combustion for hypersonic applications, high-pressure thermodynamics and combustion, high-energy-density materials, and cavitation in simulated cryogenic conditions. Dr. Segal received an AIAA Distinguished Service Award in 2000. He is a Member of the Combustion Institute, a Member of the American Society of Mechanical Engineers, and an Associate Fellow of the AIAA.



JERRY M. SEITZMAN Professor, Guggenheim School of Aerospace Engineering, received his B.S. degree in mechanical engineering from the University of Texas (1982) and his M.S. (1983) and Ph.D. degrees from Stanford University (1991). Dr. Seitzman's expertise is in the fields of combustion, combustion control, high-temperature gas dynamics, optical flow diagnostics, and optical sensors. He has authored more than 100 papers on these subjects. Dr. Seitzman helped pioneer the development of planar laser-induced fluorescence (PLIF), laser-induced incandescence, and sensing of flame chemiluminescence as quantitative measurement techniques. He has made important contributions to the understanding of turbulent combustion; lean blowout and combustion instability, including active control; laminar and turbulent flame speeds of hydrocarbon and syngas fuels at gas turbine operating conditions; burning of solid propellants, including those with nanoaluminum; and the development of new combustor technologies. Dr. Seitzman was an IBM Graduate Fellow at Stanford University and a National Science Foundation Career Award recipient at Georgia Institute of Technology. He is an Associate Fellow of the AIAA and active on the AIAA Aerodynamic Measurement Technology Committee, where he was a past National Meeting Chair and Awards subcommittee chair. Prof. Seitzman is also a member of the Executive Committee of the Eastern States Section of the Combustion Institute. He holds three patents in combustion technology. He is also a five-time recipient of the School of Aerospace Engineering students' Most Valuable Faculty award.



STEVEN F. SON received his Ph.D. from the University of Illinois at Urbana–Champaign and is currently a Project Leader and Technical Staff Member at Los Alamos National Laboratory. He was a J. R. Oppenheimer Fellow at Los Alamos from 1993 to 1996. He has given numerous invited lectures at several research institutions and at meetings of the Material Research Society, American Physical Society, International Pyrotechnics Seminar, and Gordon Research Conferences. He has studied the combustion of energetic materials for over 15 years. His research interests include advanced energetic materials, microenergetics, microchannel combustion, nanoscale composite energetic materials, oscillatory combustion, instabilities, deflagration-to-detonation transition, and diagnostics. Dr. Son is a Member of the American Physical Society, the American Society of Mechanical Engineers, and the American Institute of Aeronautics and Astronautics. Dr. Son is currently an Associate Professor of mechanical engineering at Purdue University.



GREGORY G. SPANJERS is currently the Chief Space Experimentalist for the U.S. Air Force Research Laboratory (AFRL), Space Vehicles Directorate, Kirtland Air Force Base (AFB). He is a Senior Leader within the U.S. Air Force (ST rank). Dr. Spanjers received the degrees of B.S. in physics and B.S. in mathematics from the University of Minnesota in 1986. He received his M.S. degree in 1990 and his Ph.D. in 1992 from the University of Washington, performing plasma physics research for magnetically confined fusion. After working in industry and academia, he joined the AFRL Spacecraft Propulsion Branch, Edwards AFB, and served as Principle Scientist, Group Leader, Technical Advisor, and Acting Branch Chief. Dr. Spanjers transferred to the AFRL Space Vehicle Directorate in 2002, where he established and led major space experiments such as the Demonstration and Science Experiment, Calibrated On-Orbit Objects Program, Third-Generation Infrared Surveillance System Risk Reduction, and the payload development for the Commercially Hosted Infrared Payload. He currently provides scientific oversight for the AFRL space experiment portfolio. Dr. Spanjers has authored 30 journal papers, 70 contributed papers, and 10 patents. He is an AFRL Fellow and an Associate Fellow of the AIAA.



DR. CHOON SOOI TAN is Senior Research Engineer at the Massachusetts Institute of Technology (MIT) Gas Turbine Laboratory. He received his B.S. in engineering from Victoria Manchester University in 1974, M.S. in aeronautics from the California Institute of Technology in 1975, and Ph.D. in aeronautics and astronautics from MIT in 1978. His research interests include unsteady three-dimensional flow and aerostructural interactions in multistage turbomachinery/propulsion systems. He has authored or coauthored approximately 35 publications on internal flows, turbomachinery, and fluid mechanics in archival journals. He is a coauthor of the book *Internal Flow: Concepts and Applications* (Cambridge University Press, 2004). He is a Senior Member of the AIAA.

Editorial Advisory Board



MEYER J. BENZAKEIN received his mechanical engineering degree in 1960. He received an M.S. in mechanical engineering in 1963 and a Ph.D. in engineering mechanics in 1967. He joined General Electric in 1967, where he served in a number of positions in Advanced Technology and Project and Product Engineering. He led the CFM56 Engineering Program from 1984 to 1993 and the GE90 Engineering Program from 1993 to February 1995. In February 1995, Dr. Benzakein became General Manager for Engine Systems Design and Integration, and in this capacity he had the responsibility for engineering leadership and technical oversight of GE Evendale Commercial and Military Aircraft Engines. In January 1996, Dr. Benzakein took over the position of General Manager of Advanced Engineering Programs. He maintained that position until he retired in October 2004. He was responsible for leading the Technology Development efforts and the new commercial and military engines development programs. Dr. Benzakein joined the faculty of The Ohio State University in January 2005. Dr. Benzakein was elected as a Member of the National Academy of Engineering in 2001. That year he also received the Gold Medal Award from the Royal Aeronautical Society. He was elected a Fellow of the Royal Aeronautical Society in 2002, a Fellow of the American Institute of Aeronautics and Astronautics in 2004, and a Fellow of the American Society of Mechanical Engineers in 2007. He was the recipient of the AIAA Reeds Award for Excellence in Aeronautics in 2007.



SÉBASTIEN CANDEL, Professor of Aerospace Engineering and Head of Mechanical and Aerospace Studies at Ecole Centrale Paris, received his engineering degree from Ecole Centrale Paris in 1968, Ph.D. from the California Institute of Technology in 1972, and the Doctorat d'Etat from the University of Paris 6 in 1977. He was a Research Scientist at ONERA (the French Aerospace Research Laboratory) from 1973 to 1987 and an Assistant Professor at the University of Compiègne from 1975 to 1978. Since 1978 he has been a Professor at Ecole Centrale Paris. In 2001 he was appointed as a Senior Member of the Institut Universitaire de France. He was awarded the silver medal of the Centre National de la Recherche Scientifique in 1993, received the Marcel Dassault Grand Prize from the Academy of Sciences in 2000, the Aeroacoustics Award from the Confederation of European Aerospace Societies in 2004, and the Pendray Aerospace literature award from AIAA in 2005. He is a Fellow of the Association Aéronautique et Astronautique de France, the Institute of Physics, and the AIAA. He has been a Corresponding Member of the French Academy of Sciences since 1994 and a Member of the Academy of Technology since 2000. He was a Vice President of the Combustion Institute and is a Member of the Research and Technology Evaluation Committee of the Centre National d'Etudes Spatiales. He has been an Associate Editor of *Combustion and Flame* (2000–2008) and of the *Comptes Rendus de l'Académie des Sciences* since 1994. He also serves on the Editorial Boards of *Combustion Science and Technology*, *Progress in Energy and Combustion Science*, *Journal of Turbulence*, and *Aerospace Science and Technology*. His research interests are in combustion and propulsion. He is the author or coauthor of two books and of more than 300 articles and papers.



NICHOLAS A. CUMPSTY is Emeritus Professor of mechanical engineering in Imperial College London. Until the beginning of 2005, he was Chief Technologist for Rolls-Royce, plc, and before 2000 he was Professor of aero-thermal technology at the University of Cambridge and Director of the Whittle Laboratory. He received his B.Sc. from Imperial College in mechanical engineering and his Ph.D. at the University of Cambridge for work on three-dimensional boundary layers. After a period as a Research Fellow in Cambridge, Dr. Cumpsty worked for Rolls-Royce in the area of noise until returning to the University of Cambridge to join the teaching staff in 1972. He was the Hunsaker Visiting Professor in the Department of Aeronautics and Astronautics, Massachusetts Institute of Technology, from 1991–1992. He has received the American Society of Mechanical Engineers (ASME) Gas Turbine Award on two occasions and the George Stephenson Medal of the Institution of Mechanical Engineers. In addition to many technical papers, Dr. Cumpsty has written two major books: *Compressor Aerodynamics* was published in 1989 (and was reprinted in 2004) and the second edition of *Jet Propulsion* appeared in 2003. He is a Member of the Royal Commission on Environmental Pollution and the Defence Science Advisory Council. He is also currently a Visiting Professor in the Department of Aeronautics and Astronautics at Massachusetts Institute of Technology. Dr. Cumpsty is a Fellow of the AIAA and ASME as well as a Fellow of the Royal Academy of Engineering.



EDWARD M. GREITZER is the H. N. Slater Professor of aeronautics and astronautics at Massachusetts Institute of Technology (MIT). He received his A.B., S.M., and Ph.D. from Harvard University. Before joining MIT in 1977, he was with United Technologies Corporation, and he was again at United Technologies Research Center as Director of Aeromechanical, Chemical, and Fluid Systems while on leave from MIT. Dr. Greitzer is a former Director of the MIT Gas Turbine Laboratory. He is a three-time recipient of the American Society of Mechanical Engineers (ASME) Gas Turbine Award for outstanding gas-turbine paper of the year, an ASME Freeman Scholar in Fluids Engineering, and a recipient of publication awards from AIAA and the Institution of Mechanical Engineers. He has received the Aircraft Engine Technology Award from the ASME International Gas Turbine Institute (IGTI), the R. Tom Sawyer Award from the ASME, and the Exceptional Civilian Service medal from the U.S. Air Force. He has been a Member of the U.S. Air Force Scientific Advisory Board, the NASA Aeronautics Advisory Committee, and the IGTI Board of Directors (Chair from 1996–1997). He is the lead author of the book *Internal Flow: Concepts and Applications*, published by Cambridge University Press. Dr. Greitzer is a Fellow of the AIAA and ASME, an Honorary Professor at Beihang University, a Member of the National Academy of Engineering, and an International Fellow of the Royal Academy of Engineering.



RONALD K. HANSON earned engineering degrees from Oregon State University, Arizona State University, and Stanford University. He has been affiliated with Stanford University since 1972, and he is presently the Woodard Chair of Mechanical Engineering (ME). He served as the ME Department Chair at Stanford from 1993–2003, and he has advised more than 70 Ph.D. students. His research has been in the fields of laser diagnostics and sensors, shock wave physics, and combustion chemistry, and he is the author or coauthor of over 400 archival publications in these areas. Dr. Hanson is a Fellow of the AIAA, the American Society of Mechanical Engineers, and the Optical Society of America, and he is a Member of the National Academy of Engineering. He is a recipient of the Silver Medal and the Alfred Egerton Gold Medal from The Combustion Institute and multiple awards from the AIAA.



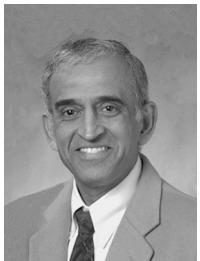
BORIS I. KATORGIN, General Designer of Research and Production Association of Power Engineering, named after academician V. Glushko (Joint Stock Company NPO ENERGOMASH). He graduated from Bauman High Engineering School in 1958. He made his way up from Mechanical Engineer and Design Engineer to General Director and General Designer of NPO ENERGOMASH (from 1992 to 2005) and General Designer (from 2005 to present). Under his leadership, NPO ENERGOMASH made many breakthroughs in the field of liquid propellant rocket engines (LPRE), won the competition in the United States in 1996 and delivered two RD-180 engine modifications, which provided successful launches of commercial satellites on launch vehicles Atlas III and V. Other significant innovations include developments of large LPRE for the new launch vehicle Angara and engine modernization for launch vehicles Soyuz, Proton, and Zenit. Under his leadership, NPO ENERGOMASH also conducted activities in the development, research, and application of chemical lasers. He is a Member of the Russian Academy of Sciences (Academician), a Doctor of Engineering, and a Professor. He has practiced teaching for more than 30 years and is currently Chair of Energetic and Physical Systems of Moscow Aviation Institute. He is an author of 320 scientific papers, 160 inventor certificates and patents, and 7 U.S. patents. He has been awarded Orders Badge of Honor, Motherland's Distinguished Service, and the Yaroslav Mudry of V degree (Ukraine). Dr. Katorgin is the Russian Government Prize and Russian State Prize Laureate and the Honored Scientist of the Russian Federation. For many years, Dr. Katorgin has headed the board of industrial companies of the Khimki district, Moscow region, and is a Member of the Presidium of Defense Companies League as well as a Member of the Editorial Boards of the Russian scientific and technical journals *Engine and Flight*. Dr. Katorgin is an Honorary Freeman of the Khimki town and Moscow region. He is a Member of the AIAA.



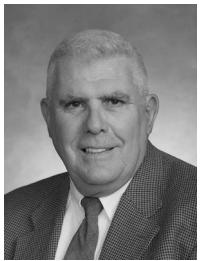
CHUNG K. (ED) LAW received a B.S. in physics from the University of Alberta in 1968, an M.A.Sc. in aerospace studies from the University of Toronto in 1970, and a Ph.D. in engineering physics from the University of California at San Diego in 1973. Since graduation, he had been associated with the General Motors Research Laboratories, Princeton University, Northwestern University, and the University of California at Davis. In 1988 he returned to Princeton University, where he has been the Robert H. Goddard Professor of mechanical and aerospace engineering since 1995. Law's research interests cover various physical and chemical aspects of fundamental combustion phenomena. He is a Fellow of the AIAA, the American Society of Mechanical Engineers, and the American Physical Society; a Member of the National Academy of Engineering; a past President of the Combustion Institute; and a recipient of a number of professional and best paper awards for technical contributions. He is an author or coauthor of over 350 journal publications.



JAMES G. MASER is President of Pratt & Whitney Rocketdyne. Before his current position, Mr. Maser served as President and General Manager of the Sea Launch Company, an international partnership that launches commercial communications satellites on a Zenit-3SL vehicle from an ocean-based launch platform on the equator. After Sea Launch, Mr. Maser brought his entrepreneurial leadership and launch vehicle experience to Space Exploration Technologies, or SpaceX, as President and Chief Operating Officer of the startup firm, which was selected by NASA to demonstrate delivery and return of cargo to the International Space Station. Mr. Maser has a strong background as an Aerospace Engineer with extensive experience in program management, design, and engineering leadership. Starting out with the Boeing Delta and Evolved Expendable Launch Vehicle programs in structural design, he became Lead of Advanced Studies in systems integration and was one of the key architects of the evolution of Delta II to Delta IV. In 1998, Mr. Maser transitioned from Chief Engineer of Delta III to Chief Engineer of Sea Launch. Before joining McDonnell Douglas (now The Boeing Company) in the 1980s, he was a Research Fellow at NASA Lewis Research Center (now John H. Glenn Research Center at Lewis Field). He is a Senior Member of the AIAA.



JAYANT S. SABNIS earned his B. Tech. from the Indian Institute of Technology and his M.S. and Ph.D. from Syracuse University. Until 1992, Dr. Sabinis worked at SRA, Inc., where he made significant contributions in the development and application of computational analyses for multiphase reacting flows in solid and liquid rocket motors. In 1992, Dr. Sabinis joined United Technologies Research Center, where he actively led several research and development programs in propulsion systems and turbomachinery. In 1998, Dr. Sabinis transferred to Pratt & Whitney (P&W) and assumed responsibility for the secondary flow and heat transfer discipline as well as for the internal air system integration in P&W engines. In 1999, he was appointed the Director of Mechanical Systems and was responsible for the engineering as well as product-delivery aspects of rotor support and lubrication systems in P&W engines. He led the group in developing analytical approaches to design and analysis of mechanical systems and implementation of novel design concepts to manage fluid flows in lubrication systems. In 2002, Dr. Sabinis was appointed the Director of Aerodynamics, and he was responsible for all aspects of aerodynamic designs of P&W engines, defining technology programs related to the aerodynamics discipline, and interrogating results to validate the design process. In 2004, Dr. Sabinis assumed his current responsibility as the Chief Engineer of Systems Analysis and Aerodynamics. In this capacity, he is responsible for all aspects of engine system performance, operability, control and diagnostic systems, and component aerodynamics and acoustics. Dr. Sabinis is a Fellow of the AIAA and a Fellow of the ASME.



ROBERT L. SACKHEIM, Assistant Director and Chief Engineer for Propulsion at NASA's George C. Marshall Space Flight Center, retired, holds a B.S. degree from the University of Virginia and an M.S. degree from Columbia University. He is an Adjunct Professor of mechanical and aerospace engineering at the University of Alabama, Huntsville, and a consultant. Previously, he spent 35 years at TRW Space and Electronics Group. His honors include the AIAA Wyld Award for contributions to rocket propulsion and 12 NASA Group Achievement Awards. At TRW, he received three annual Chairmen's Awards and a TRW Patent of the Year Award. He is a Fellow of the AIAA and was elected to the National Academy of Engineering. He also received the AIAA Sustained Service Award, the AIAA Martin Schilling Award for Outstanding Service, the AIAA Herman Oberth Award for Outstanding Achievement in the Fields of Astronautics and Space Sciences, and the AIAA Holgar Toftoy Award for Outstanding Technical Leadership in Space Systems. He received an award for High-Quality Contributions to the Propulsion Field from the Association of Aeronautics and Astronautics of France. He was awarded the NASA Medal for Outstanding Technical Leadership, and the Presidential Rank Award for Meritorious Executive Service. He was Chairman of the AIAA Liquid Propulsion Technical Committee, the AIAA Los Angeles section, and the AIAA Mississippi/Alabama section. He has served on numerous NASA and National Research Council boards and special committees. He has authored over 250 technical papers and holds 9 patents.



WILLIAM A. SIRIGNANO serves as Professor of mechanical and aerospace engineering and of chemical engineering and materials science and occupies the Henry Samueli Endowed Chair in Engineering at the University of California, Irvine. He received a B.S. degree from Rensselaer Polytechnic Institute and M.A. and Ph.D. degrees from Princeton University. He has served as Dean, School of Engineering, University of California Irvine; George Tallman Ladd Professor and Department Head, Carnegie-Mellon University; and Professor, Princeton University. His major research and teaching interests include spray combustion, turbulent combustion and ignition, aerospace propulsion, fluid dynamics, and applied mathematics. He has over 400 research papers and nearly 300 research seminars and presentations. Professor Sirignano's awards and recognitions include an AIAA Pendray Aerospace Literature Award, Propellants and Combustion Award, Energy Systems Award, and Sustained Service Award; American Society of Mechanical Engineers (ASME) Freeman Scholar Fluids Engineering Award; The Combustion Institute Alfred C. Egerton Gold Medal; Institute for the Dynamics of Explosions and Reactive Systems (IDERS) Oppenheimer Award; American Electronics Association, Orange County Council Award; President's Award for Engineering Excellence in Service to Higher Education, Orange County Engineering Council; and the University of California, Irvine, Alumni Distinguished Research Award. He is a Member of the National Academy of Engineering; a Fellow of the AIAA, ASME, American Association for the Advancement of Science, and American Physical Society; and a Research Fellow of United Aircraft. Professional service has included Chair, Microgravity Research Committee of the National Research Council Space Studies Board; NASA Space Science and Applications Advisory Committee; AIAA Publications Committee; Chairman, AIAA Solid Rockets Technical Committee; Executive Committee, Treasurer, and Board of Directors, The Combustion Institute; President, IDERS; Series Editor, *Combustion Science and Technology* (Taylor and Francis); and Editorial Advisory Boards for *Combustion Science and Technology*, *Combustion and Flame*, *Atomization and Sprays*, *Progress in Energy and Combustion Science*, *Archivum Combustionis*, and *Journal of Propulsion and Power*.



ANTHONY J. STRAZISAR is currently the Technical Advisor to the NASA Fundamental Aeronautics Program. Previous to this assignment, he served as the Chief Scientist of the NASA John H. Glenn Research Center at Lewis Field (GRC) for four years. He earned his B.S., M.S., and Ph.D. in engineering from Case Western Reserve University and joined GRC in 1976. His early work focused on the acquisition and analysis of laser anemometer measurements in high-speed rotating machinery to advance the basic understanding of turbomachinery fluid mechanics and for turbomachinery computational fluid dynamics code validation. His more recent work has focused on the development of fluid injection schemes to control compressor stall and to increase the aerodynamic loading of compressor blading. He has received the NASA Exceptional Engineering Achievement Medal and the AIAA Airbreathing Propulsion Award. He is a four-time recipient of GRC's Best Publication Award. He is a Fellow of the American Society of Mechanical Engineers (ASME) and the ASME Vice President-Elect for the ASME International Gas Turbine Institute. He is a Senior Member of the AIAA.



XIAOFENG SUN is a Professor of Aerospace Engineering at the Beijing University of Aeronautics and Astronautics (BUAA), where he directs the Fluid and Acoustic Engineering Laboratory. His principal fields of interest include unsteady flows in turbomachines, vortex dynamics, and aeroacoustics. The work includes experimental, theoretical, and computational investigations into vortex-sound interactions, flow stabilities in compressors, control of blade flutter, and acoustic design of aeroengine nacelles, as well as various strategies for fan and compressor noise reduction. Professor Sun received his Ph.D. in aerospace engineering from BUAA in 1988 and his M.S. (1985) and B.S. (1982) in mechanical engineering from Shanghai Jiaotong University. He was a Visiting Research Fellow of DLR, German Aerospace Center, at the Institute for Experimental Fluid Mechanics from 1992 to 1994, a Visiting Professor at the University of Tokyo from 1997 to 1998, a Visiting Professor at Pennsylvania State University in 2001, and a Visiting Professor at the Ecole Centrale Lyon in 2008. He has published one book and more than 100 technical papers. He was the recipient of the National Science Funds for Distinguished Young Scholars in 1999. He is a Member of the International Advisory Committee of the Gas Turbine Society of Japan and a Member of the Standing Committee of the Chinese Society of Engineering Thermophysics. Currently, he is an Endowed Chair Professor sponsored by the Cheung Kong Scholarship Program, designated by the Ministry of Education of China. He is a Senior Member of the AIAA.



JUE WANG is the General Director of China's New Generation Launch Vehicle. After graduating from Xian Jiao-Tong University, Mr. Wang joined the Beijing Aerospace Propulsion Institute in 1982 and later became the Director of the Institute and the Vice Chief Designer of the Long March III launch vehicle. His earlier work involved the system design and analysis of cryogenic rocket engines for the Long March III rocket. He has been responsible for the development of key technologies of China's new generation of cryogenic rocket engines since 1995. He has served as the leader of an expert group of a national high-tech aerospace committee since 1998, managing a wide variety of research and development projects in rocket and airbreathing propulsion at the national level. Mr. Wang has made substantial contributions to the field of rocket engine design and analysis. He plays an active role in several scientific and professional societies in China. He is a Member of the Executive Council of the Chinese Society of Astronautics, a Cochair of the Liquid Rocket Propulsion Committee of the Chinese Society of Astronautics, and a Member of the Advisory Council of the Chinese Society of Engineering Thermophysics. He is a Corresponding Member of the International Academy of Astronautics and a Senior Member of the AIAA.



VIGOR YANG, William R. T. Oakes Professor and Chair of the School of Aerospace Engineering at the Georgia Institute of Technology (GIT), received his Ph.D. from the California Institute of Technology. Before joining the faculty at GIT, he was the John L. and Genevieve H. McCain Chair in Engineering at Pennsylvania State University. His research interests include combustion instabilities in propulsion systems, chemically reacting flows in airbreathing and rocket engines, combustion of energetic materials, and high-pressure thermodynamics and transport. He has supervised 41 Ph.D. and 15 M.S. theses. He is the author or coauthor of more than 300 technical papers in the areas of propulsion and combustion and has published 10 comprehensive volumes on rocket and airbreathing propulsion. He was the recipient of the Pennsylvania State Engineering Society Premier Research Award and several publication and technical awards from AIAA, including the airbreathing Propulsion and Pendry Aerospace Literature Awards. Dr. Yang also serves on the Editorial Advisory Boards of *Combustion and Flame*, *Progress in Energy and Combustion Science*, *Combustion, Explosion, and Shock Waves*, *Journal of Aeronautics, Astronautics, and Aviation*, *Journal of the Chinese Institute of Engineers*, and *JANNAF Journal of Propulsion and Energetics*. He has been a consultant to many U.S. rocket and gas-turbine engine companies as well as government organizations. Dr. Yang is a Fellow of the AIAA and American Society of Mechanical Engineers.



RICHARD A. YETTER, Professor of Mechanical Engineering at Pennsylvania State University, received his B.S. from Syracuse University, M.S. from Cornell University, and M.A. and Ph.D. from Princeton University. His current research interests include micro power and propulsion systems, nanoenergetic material combustion, noncryogenic hydrogen storage for propulsion, high-temperature/high-pressure combustion chemistry, and heterogeneous combustion. His research experience has also included the development and analysis of stratified-charge internal-combustion engines; alternate-fuel combustion; analysis of turbulent flames with swirl stabilization; development and analysis of complex reaction mechanisms; measurement of elementary reaction-rate constants; absorption- and laser-induced fluorescence spectroscopy; metal combustion; and development of a sensitivity analysis theory to combustion kinetics modeling. He was previously a Research Engineer at the Scientific Research Laboratories of Ford Motor Company, a Senior Research Scientist and Lecturer at Princeton University, and a Research Collaborator at the Brookhaven National Laboratory. He is currently Director of a Multidisciplinary University Research Initiative at Pennsylvania State University on nanoengineered energetic materials that is supported by the U.S. Army. He is Editor-in-Chief of *Combustion Science and Technology*, Coeditor of the 30th and 31st *Proceedings of the Combustion Institute*, and currently serves on the Editorial Board of *Progress in Energy and Combustion Science*. Dr. Yetter is an author or coauthor of over 200 scientific publications and 2 U.S. patents, and he is the recipient of the Silver Medal and the 2006 Distinguished Paper Award from the Combustion Institute. He is a Senior Member of the AIAA.



BEN T. ZINN is the David S. Lewis Jr. Chair of Aerospace Engineering and Regents' Professor with a joint appointment at the George W. Woodruff School of Mechanical Engineering, Georgia Institute of Technology. Dr. Zinn received his B.S. in mechanical engineering from New York University in 1961, M.S. in mechanical engineering from Stanford University, and M.A. and Ph.D. in aerospace and mechanical sciences from Princeton University in 1963 and 1965, respectively. He joined the faculty at Georgia Institute of Technology in 1965, where he was promoted to Regents' Professor in 1973. Dr. Zinn was appointed to the Lewis Chair in 1992. Over the years, Dr. Zinn has made research contributions in the areas of combustion instabilities, pulse combustion, combustion, acoustics, fire safety, and active control of combustion processes. Dr. Zinn is presently serving as Director of the recently awarded NASA University Research, Engineering and Technology Institute at Georgia Institute of Technology on Aeropropulsion and Power. Dr. Zinn has served on the AIAA Propellants and Combustion Technical Committee and was Associate Editor of the *AIAA Journal*. He also served on the Editorial Board of *Progress in Energy and Combustion Science* and currently serves on the Editorial Board of *Combustion Science and Technology*. Dr. Zinn's awards include The Combustion Institute 2002 Alfred C. Egerton Gold Medal for Distinguished Continuing and Encouraging Contributions to the Field of Combustion. He is a Member of the National Academy of Engineering and a Fellow of the AIAA and American Society of Mechanical Engineers, as well as a recipient of the AIAA Pendray and Combustion and Propellants Awards and the George Institute of Technology Outstanding Professor Award. He was an Honorary Professor at Beijing University of Aeronautics and Astronautics. He has advised the research activities of more than 35 Ph.D. students and many M.S. and undergraduate students. Some of these students have won national and regional awards. Dr. Zinn is author or coauthor of over 400 articles and papers.